

WORKING P A P E R

Quality Indicators for Quality of Care During Hospitalization for Vulnerable Elder Persons

ERIC C. KLEERUP
DAVID H. SOLOMON

WR-179

August 2004

This product is part of the RAND Health working paper series. RAND working papers are intended to share researchers' latest findings and to solicit informal peer review. They have been approved for circulation by RAND Health but have not been formally edited or peer reviewed. Unless otherwise indicated, working papers can be quoted and cited without permission of the author, provided the source is clearly referred to as a working paper. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. RAND® is a registered trademark.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 00 AUG 2004		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Quality Indicators for Quality of Care During Hospitalization for Vulnerable Elder Persons				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) UCLA Department of Medicine, Division of Pulmonary & Critical Care Medicine, 37-131 CHS, Box 951690, Los Angeles, CA 90095-1690				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 28	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

**QUALITY INDICATORS FOR QUALITY OF CARE DURING HOSPITALIZATION
FOR VULNERABLE ELDER PERSONS**

Eric C. Kleerup, MD¹

David H. Solomon, MD²

UCLA Department of Medicine

Division of Pulmonary & Critical Care Medicine¹; Division of Geriatrics²

This study was supported by a contract from Pfizer Inc. to RAND

Address correspondence to:

Eric C. Kleerup, MD

UCLA Department of Medicine

Division of Pulmonary & Critical Care Medicine

37-131 CHS, Box 951690

Los Angeles, CA 90095-1690

(310) 794-6593 / FAX (310) 206-8622

Word count: 3,588

Number of tables: 2

Introduction

Admission to the hospital is a near certainty during the lifetime of vulnerable elders. A hospital stay can be associated with serious declines in health and function and utilization of significant health care resources. This paper aims to describe quality of care indicators for vulnerable elders who are hospitalized. While many of the ACOVE conditions, such as congestive heart failure, pressure ulcers, and ischemic heart disease, contain indicators for the quality of hospital care associated with that condition, this paper focuses on general or inter-condition indicators of hospital quality of care.

Methods

The methods for developing these quality indicators, including literature review and expert panel consideration, are detailed in a preceding paper.(1) For hospitalization, the structured literature review identified 8,933 titles, from which abstracts and articles were identified that were relevant to this report. Based on the literature and the authors' expertise, 23 potential quality indicators were proposed.

Results

Of the 23 proposed indicators, 9 were judged valid by the expert panel process (see Quality Indicator table), two were merged into other indicators, and 12 were not accepted. The literature summaries that support each of the indicators judged to be valid by the expert panel process are described below.

Quality indicator #1:

Evaluation of the Vulnerable Elder at Hospital Admission

IF a vulnerable elder is admitted to the hospital for any acute or chronic illness or any surgical procedure, **THEN** the evaluation should include within 24 hours: (1) diagnoses, (2) pre-hospital and current medications, and (3) cognitive status, **BECAUSE** poor function in these domains predicts functional decline and poor post-hospital outcomes, which may be amenable to intervention.

Supporting evidence: Cognitive dysfunction and specific conditions and medications are associated with poor hospital outcomes, as indicated by increased morbidity, mortality, length of stay, discharge to assisted care rather than independent living, and cost. However, evidence that interventions, based on evaluation of these domains, can improve outcomes is either limited, non-existent, or confounded by multiple interventions. Some of the medical record documentation required by this indicator may also be useful in adjusting case mix to evaluate quality of care.

Most geriatric consultation,(2) geriatric special care unit studies (3,4,5,6) or hospital-wide geriatrics interventions (7) use a form of comprehensive evaluation and direct interventions on the dysfunction discovered. Thus, the multi-dimensional assessment may allow "targeting" of interventions to those most likely to benefit. The reasons that each of the elements is necessary are discussed below:

Diagnoses: The identification of past and current diagnoses is fundamental to medical treatment. Vulnerable elders often have several comorbidities that may affect the approach to hospital care.

Pre-hospital and current medications: In a retrospective review, adverse drug reactions occurred in 0.7% of hospitalized patients of all ages and represented 19.4% of all complications in those patients.(8) Over 50% of adverse events due to drug treatment were considered the result of negligence. An error in dose or method of use occurred in 42% of the cases, inappropriate use of a drug in 22%, and inadequate follow-up of therapy in 45% of cases. Daily prospective monitoring detected adverse drug events in 14.6% of hospitalized elderly patients and 54.2% of those events were judged preventable.(9) Adverse drug events were associated with an additional length of stay of 2.2 days (4.6 for preventable events) and an additional cost of \$2595 (\$4685).(10) As many as 10% of hospital admissions in the elderly may be due, at least in part, to adverse drug reactions.(11) Simple enumeration of the current and recent past medications is the first step in preventing interactions and adverse events.

Cognitive status: Risk of functional decline is predicted by increasing age, lower Mini-Mental Status Exam (MMSE) scores on admission, and lower functional status (measured as preadmission instrumental activities of daily living).(12) No direct evidence exists to demonstrate that a baseline mental status examination will improve the subsequent diagnosis and treatment of delirium. However, several reviews of delirium, as well as the relevant Agency for Health Care Policy and Research (AHCPR) guideline,(13) recommend a baseline cognitive status examination, based on the high incidence of delirium after medical or surgical admission to the hospital as well as the fact that the most important and difficult differential diagnosis of delirium is dementia. One prerequisite for a diagnosis of delirium is convincing evidence that a change has occurred from the baseline mental status. Since dementia is so common among vulnerable elders (both in the hospital and in nursing homes), the baseline assessment of cognitive status is essential. Finally, dementia is the most important predisposing risk factor for

delirium, even exceeding “age greater than 80” in predictive power, so compromised cognition is a serious warning sign of susceptibility to delirium during the hospitalization.

Difficulties with *emotion*, particularly depression and anxiety, and *hearing* (14) are common in hospitalized elderly patients and are treatable. Documentation concerning baseline emotional status and sensory function is advisable for hospitalized vulnerable elders, however the ACP-ASIM Task Force on Aging found quality indicators requiring such documentation to be infeasible.

Quality indicator #2:

Discharge Planning

IF a vulnerable elder enters the hospital, **THEN** discharge planning should begin within 48 hours, **BECAUSE** this process decreases readmissions and length of hospitalization.

Supporting evidence: Comprehensive discharge planning has been shown to reduce the rate of hospital readmission over the short term. The components of discharge planning vary greatly, and the specific components responsible for decreased readmission have not been identified. A randomized clinical trial of comprehensive discharge planning in patients over age 70 demonstrated a reduction in readmissions, primarily in the first 2 weeks (4% versus 16%).⁽¹⁵⁾ This comprehensive discharge planning protocol included an initial in-hospital visit with assessment of the patient and caregiver within 24 hours of admission, interim in-hospital visits, a post-discharge visit and telephone availability for 2 weeks following discharge. For 12 weeks following discharge for cardiac diagnoses (congestive heart failure, angina, myocardial infarction, coronary artery bypass grafting or cardiac valve replacement), the readmission rate was 22% in the intervention group and 33% in the control group (95% CI for the difference -

26% to 4%). Hospital days and total costs were also reduced in the intervention group for the first six weeks after discharge but not between six to twelve weeks.

Quality Indicator #3:

Endocarditis Prevention

IF a vulnerable elder has valvular or congenital heart disease, intracardiac valvular prosthesis, hypertrophic cardiomyopathy, mitral valve prolapse with regurgitation, or previous episode of endocarditis and a high risk procedure is planned, **THEN** endocarditis prophylaxis should be given, **BECAUSE** prophylaxis helps prevent endocarditis.

Supporting evidence: There are no randomized controlled human trials of patients with underlying structural heart disease that assess the value of antibiotic prophylaxis in the prevention of infectious endocarditis following bacteremia-inducing procedures. It is unlikely that any such studies will ever be performed, as strong evidence from observational studies in humans regarding antibiotic use and procedure-induced bacteremia combined with experimental evidence from randomized studies of animal models of infective endocarditis have led the American Heart Association (AHA) and others to establish guidelines for antibiotic prophylaxis of endocarditis.(16) This indicator is satisfied if the AHA guidelines are followed.

A population-based case control study of 273 cases of community-acquired endocarditis reported that the incidence among non-I.V. drug users was 5.14 community residents per 100,000 person-years. The strongest risk factors for endocarditis following a high risk procedure were mitral valve prolapse, congenital heart disease, cardiac valve surgery, rheumatic fever and heart murmur (odds ratio of 16.7, 95% CI 7.4-37.4). Interestingly, only 38% of the patients were previously aware of their cardiac abnormalities.(17)

One case-control study has assessed the efficacy of antibiotic prophylaxis at preventing endocarditis after dental procedures. Eight cases of patients with previously known moderate or high-risk structural heart lesions whose first-time native-valve infective endocarditis occurred within 12 weeks of a dental procedure were compared with 24 controls matched with similar echocardiographically-proven lesions, dental procedures and age. The study reported a 91% protective efficacy of antibiotic prophylaxis (odds ratio=0.09, upper 95% CI 0.93).(18)

Conformity with the American Heart Association guidelines has been reported to be poor. In one study at a university hospital, between 1987-1990 just 22% of 131 eligible cases received prophylaxis in accordance with the guidelines (19). In 20% of the cases where prophylaxis was indicated none was given.

Quality indicator #4:

Deep Vein Thrombosis and Pulmonary Embolus Prevention

IF a hospitalized vulnerable elder is at very high risk for venous thrombosis, **THEN** the patient should have venous thromboembolism prophylaxis, **BECAUSE** very high risk patients have a 4 to 10% chance of clinical pulmonary embolus and a 1 to 5% chance of fatal pulmonary embolus, and prophylaxis is effective at reducing this risk.

Supporting evidence: Numerous randomized controlled trials and a meta-analysis have resulted in a consensus statement supporting the efficacy of appropriate prophylaxis to reduce the risk of thromboembolism. For this indicator, acceptable thromboembolism prophylaxis is defined as adjusted-dose heparin, low molecular weight heparin or warfarin, or low dose unfractionated heparin with intermittent pneumatic compression.

A consensus statement (20) from the American College of Chest Physicians rated the evidence in support of various methods of deep venous (and therefore pulmonary embolism) prophylaxis. Without prophylaxis, the very high risk group had a risk of 40 to 80% for calf vein thrombosis, 10 to 20% for proximal vein thrombosis, 4 to 10% for clinical pulmonary embolus, and 1 to 5% for fatal pulmonary embolus. Very high risk conditions were defined as hip fracture as well as all abdominal, pelvic or lower extremity surgeries above the shin, except laparoscopic surgeries, and patients with prior venous thromboembolism or hypercoagulable states. The relative risk reductions for acceptable regimens of prophylaxis were 60 to 72%. These findings are supported by other systematic reviews.(21, 22) In comparison, low dose unfractionated heparin alone was effective (e.g. 39% risk reduction in studies of patients receiving total hip replacements) but inferior to the acceptable regimens above. Pulmonary embolism, the sequelae of deep vein thrombosis is a potentially lethal disease, and compliance with suggested prophylaxis is low.(23)

Quality indicator #5:

Stress Ulcer Prevention

IF a hospitalized vulnerable elder has peptic stress ulcer risk factors, **THEN** the patient should receive prophylaxis with either a histamine-2 receptor antagonist (H₂-blocker), sucralfate, or a proton pump inhibitor (PPI), **BECAUSE** prophylaxis decreases the risk of gastrointestinal bleeding.

Supporting evidence: Stress related gastric hemorrhage occurs in 5 to 10% of ICU patients, with a mortality rate of more than 30%. Risk factors for stress ulcers include respiratory failure (mechanical ventilation >48 hours) and coagulopathy (platelet count < 50,000/ml, international

normalized ratio > 1.5, partial thromboplastin time > 2.0 times control). The efficacy of medications to prevent stress related gastric hemorrhage is about 50%. Antacids, H₂-blockers, PPIs, and sucralfate have all been used for stress ulcer prophylaxis, but the drug of choice is unclear.

In a prospective multicenter cohort study of 2252 patients, 1.5% (95% CI = 1.0 to 2.1%) had clinically important bleeding.(24) Univariate analysis showed that respiratory failure, coagulopathy, hypotension, sepsis, hepatic failure, renal failure, enteral feeding, glucocorticoid administration, organ transplantation and anticoagulant therapy were significant predictors of bleeding. Multiple regression analysis showed that respiratory failure (odds ratio 15.6) and coagulopathy (odds ratio 4.3) were the only statistically significant risk factors. Mortality was 48.5% in the group with bleeding and 9.1% in the group without bleeding.

A number of randomized clinical trials have evaluated medications to prevent stress ulcers and there have been several meta-analyses summarizing these studies.(25-30) A meta-analysis of 16 prospective trials (total N=2133) reported that prophylaxis with either cimetidine or antacids against clinically overt stress ulcer bleeding in patients at increased risk is equivalent and superior to placebo (stress ulcer rate of 2.7%, 3.3%, and 15%, respectively)(25). A subsequent meta-analysis reviewed 63 randomized trials (30) and reported that prophylaxis with H₂-blockers decreased the incidence of both overt gastrointestinal bleeding (odds ratio=0.58; CI 0.42-0.79) and clinically important bleeding (odds ratio=0.44; CI 0.22-0.88). Sucralfate decreased overt bleeding in fewer studies (odds ratio=0.58; CI 0.34-0.99), but its effect on clinically important bleeding has been inadequately studied. A trend toward decreased overt bleeding was seen with antacids (odds ratio=0.66; CI 0.37-1.17). In direct comparisons, H₂-blockers appear to be superior to antacids (risk ratio=0.56; CI 0.37-0.84) for overt bleeding. The

efficacy of sucralfate appeared similar to both antacids and H₂-blockers, calling into question the optimal choice of drug.

The latter meta-analysis also reported that use of sucralfate may be associated with fewer cases of pneumonia and with lower mortality than use of H₂-blockers, but this was not supported by two subsequent randomized clinical trials comparing the two. One of these trials reported no difference between sucralfate and cimetidine (31), while the other reported ranitidine to be more effective than sucralfate (odds ratio 0.44, 95% CI 0.21-0.92) and that ranitidine was not associated with increased ventilator-associated pneumonia or mortality.(32) Little evaluation of the efficacy of PPIs for this indication has been carried out. Moreover, the proportion of subjects who were “vulnerable elders” in the above studies and meta analyses could not be determined.

Quality indicator #6:

Competency for Informed Consent

IF a vulnerable elder is to have an inpatient or outpatient elective surgery, **THEN** there should be medical record documentation of the patient’s ability to understand risks, benefits, and consequences of the proposed surgical operation before the operative consent form is presented for signature, **BECAUSE** the operative consent is valid only if patients have decision making capacity when it is granted.

Supporting evidence: Patient autonomy is a basic tenet of medical care in the U.S. Informed consent implies the ability to understand the risks, benefits, and consequences of the proposed operation. If delirium or dementia are sufficient to prevent comprehension of the risks,

benefits, and consequences of a proposed procedure, meaningful consent to the procedure cannot be given.

In a study of 84 elderly persons with delirium during their hospital stay, receiving 173 medical or surgical procedures, 19% had no consent documented, 20% used surrogate consent, 4% had cognitive assessments documented, 1% had legal consults documented, and none had an assessment of competency/decisional capacity documented.(33) Surrogates were used in 47% of cases with substantial impairment and in 4% of cases with near normal mental status near the time of consent. Surrogate decision makers should be sought to participate in the consent process if the patient lacks the capacity to consent.

Quality indicator #7:

Cardiac Evaluation Prior to Vascular Surgery

IF a vulnerable elder enters the hospital for non-emergent peripheral revascularization or aortic abdominal aneurysm repair, **THEN** a cardiac stress test should be performed, if not performed in the prior year, **BECAUSE** ischemic heart disease is common in such patients and the mortality risk of the peripheral revascularization is decreased by coronary revascularization first.

Supporting evidence: Patients with severe peripheral vascular disease or aortic abdominal aneurysm (AAA) are at high risk for coronary artery disease even without prior cardiac history or symptoms. Detection of significant coronary disease allows revascularization of the heart to precede the AAA repair or peripheral revascularization and may reduce morbidity and mortality. An ejection fraction of <50% by radionuclide ventriculography, ventricular wall motion

abnormalities, history of cigarette smoking and diabetes significantly diminish overall survival after revascularization of the extremity.(34)

Stress-based cardiac tests have a high negative predictive value (near 100%) but a low positive predictive value (13-36%) for cardiac complications (including death) following AAA repair or peripheral revascularization (see Table 1). Dipyridamole-scintigraphy has also been tested for its ability to predict outcome of peripheral revascularization. In 54 patients with a history of chest pain, prior myocardial infarction or abnormal rest ECG, evaluated prior to AAA repair or peripheral revascularization, scintigraphy showed thallium redistribution abnormalities in 41%.(37) Eleven percent of the original group received cardiac catheterization based on the dipyridamole-thallium imaging, and 30% underwent vascular surgery without further cardiac evaluation. All of those undergoing cardiac catheterization had severe multivessel coronary artery disease. Half of those who underwent vascular surgery without prior cardiac intervention had cardiac events (unstable angina, acute myocardial infarction or cardiac death). Coronary artery bypass grafting was performed in 4 of the 6 patients with severe multivessel coronary artery disease and none of those had adverse cardiac events following subsequent peripheral vascular disease. Those without evidence of redistribution abnormalities (normal or persistent defects) had no cardiac ischemic events. The degree of positivity of the dipyridamole-scintigraphy is likely important, but interpretation varies from site to site.(38, 40)

Coronary angiography of 42 consecutive aortic aneurysm repair patients showed 86% had significant coronary artery disease (48% triple- vessel or left main).(41) All 20 of the patients (non-randomized) with left main or triple vessel disease (8 with ejection fraction less than 50%) underwent myocardial revascularization 7 to 10 days prior to aneurysmectomy. Perioperative myocardial infarction and mortality rates were zero following either surgery.

Historical data suggest AAA perioperative mortality of 1 to 10% with myocardial infarction causing 20 to 45% of deaths. An ejection fraction of less than 50% and ventricular wall motion abnormalities predict an increased risk of death for three years following vascular surgery. (34) Identification and treatment of significant coronary artery disease is likely to have significant benefits beyond the immediate perioperative period.

Quality indicator #8:

Evaluation of Fever

IF a hospitalized vulnerable elder has a new fever ($T > 38.5^{\circ}\text{C}/101.3^{\circ}\text{F}$), **THEN** there should be documentation that a physician examination was performed within 4 hours (or fever evaluation performed within the last 48 hours or an alternative explanation for the fever documented in the chart), **BECAUSE** prompt evaluation leads to prompt treatment, which reduces complications.

Supporting evidence: Fever has a high sensitivity for prediction of bacteremia and possibly other serious infections. While further information is needed to identify the cause/site of infection, early diagnosis permits prompt initiation of treatment, which can improve outcome. This diagnostic evaluation can be performed by a physician or his/her designee.

Fever of 38.5°C (101.3°F) or higher has a higher sensitivity (74%) than other clinical signs, identified risk factors or biologic signs for prediction of bacteremia(42). Unfortunately, the specificity of fever is low (27%), and additional data are needed for diagnosis and treatment. In a prospective study, statistically significant risk factors for bacteremia included shock (risk ratio=7.1), bladder catheter removal (risk ratio=5.9), rigors (shaking chills) (risk ratio=4.7), total polymorphonuclear leukocyte band count greater than or equal to $1500/\text{mm}^3$ (risk ratio=4.2),

lymphocyte count less than or equal to 1000/mm³ (risk ratio=3.74), and fever over 38.5°C (101.3°F) (risk ratio=2.5, risk ratio=7.5 if bacteremia is community acquired). The presence of two or more of these six risk factors has a positive predictive value of 83% for bacteremia.

Bacteremic urinary tract infections may present clinically with confusion (30%), cough (27%), dyspnea (27%) or new urinary symptoms (20%).(43) The nonspecific nature of these symptoms indicates that evaluation of the urine should be included in all evaluations of fever.

While the threshold for “fever” was set at 38.5°C (101.3°F) for this quality indicator, it is important to realize that older adults frequently have lower basal body temperatures and blunted fever responses compared to younger adults.(44,45) It has been advocated that in elders, the definition of “fever” be a rise of 1 degree celsius above basal temperature or a threshold of 37.8 °C (100.0°F). It should also be noted that some elders with systemic infections manifest hypothermia.

Quality indicator #9:

Delirium Evaluation

IF a hospitalized vulnerable elder has a definite or suspected diagnosis of delirium, **THEN** an evaluation for potentially precipitating factors must be undertaken and identified causes treated, **BECAUSE** delirium is associated with a poor short-term and long-term prognosis, and eliminating the precipitating cause(s) is an essential part of the treatment.

Supporting evidence: The key diagnostic characteristics of delirium are acute onset, fluctuating course, inattention, disorganized thinking, and altered level of consciousness.(46) In elders, vulnerable or not, delirium is more commonly associated with hypoactivity than with agitation.(47) Delirium is a prominent risk factor for prolonged hospital stay, increased cost,

functional decline, higher institutionalization and readmission rates, and both in-hospital and subsequent mortality.(48,49,50,51) Delirium is not simply an accompaniment to adverse outcomes but an independent risk factor. (52) Delirium has high prevalence and incidence, is often undiagnosed, and is prognostically serious and potentially preventable in nearly half of patients.(47)

No direct evidence exists from clinical trials that a search for precipitating factors and subsequent treatment will improve outcomes in patients with delirium. However, the evidence is strong that many factors associated with delirium can be treated effectively. Delirium results primarily from an interaction of predisposing and precipitating factors.(53,54) The characteristics of elderly hospitalized patients that are associated with the subsequent occurrence of delirium are summarized in Table 3. Since delirium is often merely the presenting clinical picture of a serious illness, treating the underlying cause (e.g. pneumonia, CHF, diabetes, dehydration) is mandatory on its own merits. Thus, the question of whether the treatment helps the delirium is moot, although a strong consensus exists that the most important step in the treatment of delirium is indeed the successful treatment of one or more precipitating causes.(53,54,66,67,68). Since these indicators were developed, a multicomponent intervention to address important risk factors for delirium was found to reduce the incidence of delirium 34% (odds ratio 0.6, CI 0.39-0.92).(47)

Discussion

This project investigated the relationship between processes and outcomes of care and aimed to develop explicit criteria to evaluate the quality of care of elderly individuals during hospitalization. Eight indicators were judged sufficiently valid for use as measures of the quality

of hospital care for the vulnerable elderly. These indicators can potentially serve as a basis to compare the care provided by different health care delivery systems and for comparing change in care over time.

References

1. Shekelle PG, MacLean CH, Morton SC, Wenger NS. Assessing the care of vulnerable elders: Methods for developing quality indicators. *Ann Intern Med.* 2001; [In press].
2. Becker PM, McVey LJ, Saltz CC, Feussner JR, Cohen HJ. Hospital-acquired complications in a randomized controlled clinical trial of a geriatric consultation team. *JAMA.* 1987;257:2313-2317.
3. Landefeld CS, Palmer RM, Kresevic DM, Fortinsky RH, Kowal J. A randomized trial of care in a hospital medical unit especially designed to improve the functional outcomes of acutely ill older patients. *N Engl J Med.* 1995;332:1338-1344.
4. Rubenstein LZ, Josephson KR, Wieland D, English PA, Sayre JA, Kane RL. Effectiveness of a geriatric evaluation using a randomized controlled trial. *N Engl J Med.* 1984;311:1664-1670.
5. Saunders RH, Hickler RB, Hall SA, Hitzhusen JC, Ingraham MR, Li L. geriatric special care unit: experience in a university hospital. *J Am Geriatr Soc.* 1983;31:685-93.
6. Collard AF, Bachman SS, Beatrice DF. Acute care delivery for the geriatric patient: An innovative approach. *Qual Rev Bull.* 1985;11:180-5.
7. Inouye SK, Acampora D, Miller RL, Fulmer T, Hurst LD, Cooney LM Jr. The Yale Geriatric Care Program: A model of care to prevent functional decline in hospitalized elderly patients. *J Am Geriatr Soc.* 1993;41:1345-52.
8. Leape LL, Brennan TA, Laird NM, Lawthers AG, Localio AR, Barnes BA, et al. The nature of adverse events in hospitalized patients: Results of the Harvard Medical Practice Study II. *N Engl J Med.* 1991;324:377-384.

9. Gray SL, Sager M, Lestico MR, Jalaluddin M. Adverse drug events in hospitalized elderly. *J Gerontol A Biol Sci Med Sci.* 198;53:M59-63.
10. Bates DW, Spell N, Cullen DJ, Burdick E, Laird N, Petersen LA, et al. The costs of adverse drug events in hospitalized patients. *JAMA.* 1997;277:307-311.
11. Riedinger JL, Robbins LJ. Prevention of iatrogenic illness. *Clin Geriatr Med.* 1998;14:681-98.
12. Sager MA, Rudberg MA, Jalaluddin M, Franke T, Inouye SK, Landefeld CS, et al. Hospital admission risk profile HARP: identifying older patients at risk for functional decline following acute medical illness and hospitalization. *J Am Geriatr Soc.* 1996;44:251-7.
13. Early Identification of Alzheimer's and Related Dementias. AHCPR. Publications No. 97-0702; 97-0703 AHCPR/PUB-97-0704. Rockville, MD: Agency for Health Care Policy and Research, US Department of Health and Human Services, Public Health Service, 1996.
14. Shapiro NL, Shekelle PG. Quality indicators for quality of hearing care for vulnerable elderly. ACP-ASIM website.
15. Naylor M, Brooten D, Jones R, Lavizzo-Mourey R, Mezey M, Pauly M. Comprehensive discharge planning for hospitalized elderly. A randomized clinical trial. *Ann Intern Med.* 1994;120:999-1006.
16. Dajani AS, Taubert KA, Wilson W, Bolger AF, Bayer A, Ferrieri P, et al. Prevention of bacterial endocarditis: Recommendations by the American Heart Association. *JAMA.* 1997;277:1794-1801.
17. Strom BL, Abrutyn E, Berlin JA, Kinman JL, Feldman RS, Stolley PD, et al. Dental and cardiac risk factors for infective endocarditis. *Ann Intern Med.* 1998;129:761-9.

18. Imperiale TF, Horwitz RI. Does prophylaxis prevent postdental procedure infective endocarditis? A controlled evaluation of protective efficacy. *Am J Med.* 1990;88:131-6.
19. Sagert G, Austin TW, Bombassaro AM, Parbtani A. Conformity with guidelines for antimicrobial prophylaxis against bacterial endocarditis. *Am J Hosp Pharm.* 1994;51:2403-8.
20. Clagett GP, Anderson FA, Geerts W, Heit JA, Knudson M, Lieberman JR, et al. Prevention of venous thromboembolism. *Chest.* 1998;114:531S-560S.
21. Wells PS, Lensing AW, Hirsh J. Graduated compression stockings in the prevention of postoperative venous thromboembolism: A meta-analysis. *Arch Intern Med.* 1994;154:67-72.
22. Leizorovicz A, Simonneau G, Decousus H, Boissel JP. Comparison of efficacy and safety of low molecular weight heparins and unfractionated heparin in initial treatment of deep venous thrombosis: A meta-analysis. *BMJ.* 1994;309:299-304.
23. Bratzler DW, Raskob GE, Murray CK, Bumpus LJ, Piatt DS. Under use of venous thromboembolism prophylaxis for general surgery patients: physician practices in the community hospital setting. *Arch Intern Med.* 1998;158:1909-12.
24. Cook DJ, Fuller HD, Guyatt GH, Marshall JC, Leasa D, Hall R, et al. Risk factors for gastrointestinal bleeding in critically ill patients. *N Engl J Med.* 1994;330:377-81.
25. Shuman RB, Schuster DP, Zuckerman GR. Prophylactic therapy for stress ulcer bleeding: A reappraisal. *Ann Intern Med.* 1987;106:562-7.
26. Lacroix J, Infante-Rivarde C, Jenicek M, Gauthier M. Prophylaxis of upper gastrointestinal bleeding in intensive care units: a meta-analysis. *Crit Care Med.* 1989;17:862-868.

27. Cook DJ, Witt LG, Cook RJ, Guyatt GH. Stress ulcer prophylaxis in the critically ill: a meta analysis. *Am J Med.* 1991;91:519-527.
28. Tryba M. Prophylaxis of stress ulcer bleeding: a meta-analysis. *J Clin Gastroenterol.* 1991;13 Suppl 2:S44-55.
29. Cook DJ, Laine LA, Guyatt GH, Raffin TA. Nosocomial pneumonia and the role of gastric pH: a meta-analysis. *Chest.* 1991;100:7-13.
30. Cook DJ, Reeve BK, Guyatt GH, Geyland DK, Griffith LE, Buckingham L, et al. Stress ulcer prophylaxis in critically ill patients, resolving discordant meta-analyses. *JAMA.* 1996;275:308-14.
31. Ben-Menachem T, Fogel R, Patel RV, Touchette M, Zarowitz BJ, Hadzijahic N, et al. Prophylaxis for stress-related gastric hemorrhage in the medical intensive care unit. A randomized, controlled, single-blind study. *Ann Intern Med.* 1994;121:568-75.
32. Cook D, Guyatt G, Marshall J, Leasa D, Fuller H, Hall R, et al. A comparison of sucralfate and ranitidine for the prevention of upper gastrointestinal bleeding in patients requiring mechanical ventilation. *N Engl J Med.* 1998;338:791-7.
33. Auerswald KB, Charpentier PA, Inouye SK. The informed consent process in older patients who developed delirium: a clinical epidemiologic study. *Am J Med.* 1997;103:410-8.
34. Kazmers A, Moneta GL, Cerqueira MD, Healy DA, Zierler RE, Harley JD. The role of preoperative radionuclide ventriculography in defining outcome after revascularization of the extremity. *Surg Gynecol Obstet.* 1990;171:481-8.
35. Kaaja R, Sell H, Erkola O, Harjula A. Predictive value of manual ECG-monitored exercise test before abdominal aortic or peripheral vascular surgery. *Angiology.* 1993;44:11-16.

36. Eichelberger JP, Schwarz KQ, Black ER, Green RM, Ouriel K. Predictive value of dobutamine echocardiography just before noncardiac vascular surgery. *Am J Cardiol.* 1993;72:602-7.
37. Boucher CA, Brewster DC, Darling RC, Okada RD, Strauss HW, Pohost GM. Determination of cardiac risk by dipyridamole-thallium imaging before peripheral vascular surgery. *N Engl J Med.* 1985;312:389-94.
38. Madsen PV, Vissing M, Munck O, Kelbaek H. A comparison of dipyridamole thallium 201 scintigraphy and clinical examination in the determination of cardiac risk before arterial reconstruction. *Angiology.* 1992;43:306-11.
39. Bry J D, Belkin M, O'Donnell T F Jr, Mackey W C, Udelson JE, Schmid CH, et al. An assessment of the positive predictive value and cost-effectiveness of dipyridamole myocardial scintigraphy in patients undergoing vascular surgery. *J Vasc Surg.* 1994;19:112-21.
40. Lette J, Waters D, Cerino M, Picard M, Champagne P, Lapointe J. Preoperative coronary artery disease risk stratification based on dipyridamole imaging and a simple three-step, three-segment model for patients undergoing noncardiac vascular surgery or major general surgery. *Am J Cardiol.* 1992;69:1553-8.
41. Acinapura AJ, Rose DM, Kramer MD, Jacobowitz, IJ, Cunningham JN, Jr. Role of coronary angiography and coronary artery bypass surgery prior to abdominal aortic aneurysmectomy. *J Cardiovasc Surg.* 1987;28:552-7.
42. Pfitzenmeyer P, Decrey H, Auckenthaler R, Michel JP. Predicting bacteremia in older patients. *J Am Geriatr Soc.* 1995;43:230-5.

43. Barkham TMS, Martin FC, Eykyn SJ. Delay in the diagnosis of bacteremic urinary tract infection in elderly patients. *Age Ageing*. 1996;25:130-2.
44. Castle SC, Norman DC, Yeh M, Miller D, Yoshikawa TT. Fever response in nursing home residents: are the older truly colder? *J Am Geriatr Soc*. 1991;39:853-57.
45. Norman DC, Yoshikawa TT. Fever in the elderly. *Infect Dis Clin North Am*. 1996;10:93-99.
46. Inouye SK, Van Dyck CH, Alessi CA, Balkin S, Siegel AP, Horwitz RI. Clarifying confusion: The confusion assessment method. *Ann Intern Med*. 1990;113:941-8.
47. Inouye SK, Bogardus ST, Charpentier PA, Leo-Summers L, Acampora D, Holford TR, et al. A multicomponent intervention to prevent delirium in hospitalized older patients. *N Eng J Med*. 1999;340:669-76.
48. Francis J, Martin D, Kapoor WN. A prospective study of delirium in hospitalized elderly. *JAMA*. 1990;263:1097-101.
49. George J, Bleasdale S, Singleton SJ. Causes and prognosis of delirium in elderly patients admitted to a district general hospital. *Age Ageing*. 1997;26:423-7.
50. O'Keeffe ST, Lavan J. The prognostic significance of delirium in older hospital patients. *J Am Geriatr Soc*. 1997;45:174-178.
51. Cole MG, Primeau FJ. Prognosis of delirium in elderly hospital patients. *Can Med Assoc J*. 1993;149:41-6.
52. Inouye SK, Rushing JT, Foreman MD, Palmer RM, Pompei P. Does delirium contribute to poor hospital outcomes? A three-site epidemiologic study. *J Gen Intern Med*. 1998;13:234-242.

53. O'Keeffe ST, Ni Chonchubhair A. Postoperative delirium in the elderly. *Br. J Anaesth.* 1994;73:673-687
54. Parikh SS, Chung F. Postoperative delirium in the elderly. *Anesth Analg.* 1995;80:1223-32.
55. Foreman MD. Confusion in the hospitalized elderly: Incidence, onset, and associated factors. *Res Nurs Health.* 1989;12:21-29.
56. Gustafson Y, Berggren D, Brannstrom B, Bucht G, Norberg A, Hansson LI, et al. Acute confusion states in elderly patients treated for femoral neck fracture. *J Am Geriatr Soc.* 1988;36:525-30.
57. Inouye SK, Charpentier PA. Precipitating factors for delirium in hospitalized elderly persons: Predictive model and interrelationship with baseline vulnerability. *JAMA.* 1996;275:852-857.
58. Marcantonio ER, Goldman L, Mangione CM, Ludwig LE, Muraca B, Haslauer CM, et al. A clinical prediction rule for delirium after elective noncardiac surgery. *JAMA.* 1994;271:134-139.
59. O'Keeffe ST, Lavan JN. Predicting Delirium in Elderly Patients: Development and Validation of a Risk-stratification Model. *Age Ageing.* 1996;25:317-326.
60. Pompei P, Foreman M, Rudberg MA, Inouye SK, Braund V, Cassel CK. Delirium in hospitalized older persons: Outcomes and predictors. *J Am Geriatr Soc.* 1994;42:809-15.
61. Rockwood K. Acute confusion. *J Am Geriatr Soc.* 1989;37:150-54.
62. Schor JD, Levkoff SE, Lipsitz LA, Reilly CH, Cleary PD, Rowe JW, et al. Risk Factors for delirium in hospitalized elderly. *JAMA.* 1992;267:827-831.

63. Williams MA, Campbell EB, Raynor WJ, Mlynarczyk SM, Ward SE. Reducing acute confusional states in elderly patients with hip fractures. *Res Nurs Health*. 1985;8:329-37.
64. Elie M, Cole MG, Primeau FJ, Bellavance F. Delirium risk factors in elderly hospitalized patients. *J Gen Intern Med*. 1998;13:204-12.
65. Liptzin B. Delirium. *Arch Fam Med*. 1995;4:453-8.
66. Francis J, Kapoor WN. Delirium in hospitalized elderly. *J Gen Intern Med*. 1990;5:65-79.
67. Levkoff SE, Besdine RW, Wetle T. Acute confusional states (delirium) in the hospitalized elderly. *Annu Rev Gerontol Geriatr*. 1986;6:1-26.
68. Inouye SK. The dilemma of delirium: Clinical and research controversies regarding diagnosis and evaluation of delirium in hospitalized elderly medical patients. *Am J Med*. 1994;97:278-88.

Table 1: Cardiac evaluation prior to vascular surgery

Test	Positive test %	Positive predictive value	Negative test %	Negative predictive value
ECG-monitored treadmill (35)	24% ischemia	14% (death due to acute myocardial infarction within 14 days)	76%	100%
Dobutamine echocardiography (36)	36%	19% perioperative cardiac events	64%	100%
Dipyridamole scintigraphy (37)	33% thallium redistribution	50% post operative cardiac ischemic events	67%	100%
Dipyridamole scintigraphy (38)	28% abnormal in all projections	50% nonfatal cardiac complications	31% normal	100%
Dipyridamole scintigraphy (39)	13%- 2 or more non-reversible defects	37% (congestive heart failure also significant)	41% normal	100%

Table 2: Quality indicators judged by the expert panel as not valid for the assessment of care for hospitalized vulnerable elders.

												Reviews	
References	Number of Occurrences	Williams et al.(63)	Schor et al.(62)	Rockwood(61)	Pompei et al.(60)	O'Keefe & Lavan(59)	Marcantonio et al.(58)	Inouye et al.(47,57)	Gustafson et al.(56)	Francis et al.(48)	Foreman(55)	Elie et al.(64)	Liptzin(65)
Risk Factors**													
Dementia	9	•	•	•	•	•	•	•	•	•		•	•
Severe illness/ co-morbidity	6			•	•	•		•	•	•		•	•
Age	5	•	•	•			•		•			•	•
Medications	5		•					•	•	•	•	•	•
Dehydration/electrolyte disorders	4						•	•		•	•	•	
Functional deficiency	3	•					•					•	
Azotemia	3					•				•	•		
Alcoholism	2				•		•					•	•
Depression	2				•				•			•	
Infection/fever	2		•							•			
Vision impairment	1							•				•	
Iatrogenic events	1							•				•	

Table 2 (continued): Quality indicators judged by the expert panel as not valid for the assessment of care for hospitalized vulnerable elders.

												Reviews	
												Elie et al.(64)	Liptzin(65)
												Number of Occurrences	
												Williams et al.(63)	
												Schor et al.(62)	•
												Rockwood(61)	
												Pompei et al.(60)	
												O'Keefe & Lavan(59)	
												Marcantonio et al.(58)	
												Inouye et al.(47,57)	•
												Gustafson et al.(56)	
												Francis et al.(48)	
												Foreman(55)	•
References													
Risk Factors**													
Male gender												1	
Malnutrition												1	
Nonelective admission												1	
Restraints												1	
Urinary catheter												1	
Weak social supports												1	

*Included are all prospective cohort studies in which multivariate analysis (or, in one case, discriminant analysis) was performed to identify independent risk factors for delirium, which are indicated by dots.

** Risk factors are not separated on the basis of whether they are predisposing (generally synonymous with "present on admission") or precipitating (generally occurring after admission). This separation was made by Inouye et al(47,57). and by some reviewers, but it seems rather arbitrary and there is considerable overlap (e.g., a urinary tract infection or malnutrition may be present on admission or may develop later).